Agtech 2030

Self-evaluation

February 2022

Preface

The 15:th of November 2018 was a fantastic day. Andrea Råsberg at Vinnova called the representative of the Agtech 2030 team at breakfast time and informed: “We will shortly send out a press release informing that Agtech 2030 is a winner of the Vinnväxt competion. Congratulations on the win!” We were speechless with joy. The struggle to succeed with the application had been going on for one year ending up in the hearing at Vinnova’s headquarters 11 October. There we had with us, among others, Ann-Cristin Adolfsson from the aerospace company Saab and Andreas Stark from Väderstad. We had also with us physical posters with illustrations and folders filled with information about our track record and our visions.

The purpose of Vinnväxt (“Win growth program”) is to create sustainable growth in regions through the development of internationally attractive innovation environments in specific areas of strength. In the press release Vinnova wrote: “Agriculture is undergoing a technological revolution and thus faces major challenges. The goal is to establish an innovation environment for tomorrow's agriculture, with a focus on sensors, digital technology, AI and the Internet of Things. The innovation environment will also work with the development of new business models and other things that are affected by the new technology.”

The timeframe for the Agtech 2030 initiative was set ten years and the budget frame for this period of time was estimated at around 200 MSEK (ca 20 M Euro), half financial resources and half in-kind. Sweden’s innovation agency Vinnova is the main financier and Region Östergötland and Linköping University are the main co-financiers.
The text that follows is a summary and self-evaluation about the journey of Agtech 2030 until December 2021. We hope this will bring a picture of what has been achieved, challenges we came across and what we will focus on if we, hopefully, get funding for the next phase (2022–2025). We will end up in two summary tables about how we look at the outcome in relation to the goals and visions. However, to understand these summaries we want to describe and discuss some of our experiences – both positive and problematic ones. One of the most important experiences we have made during this period is hard to measure in quantitative terms, it is about the long-term effect of bringing people together from such different professional environments.

To sum up, although not all goals have been achieved exactly as formulated originally, we are very proud of what we have achieved within Agtech 2030s frame! Both in terms of bringing different people and skills together with international innovation height, and be a part av a national as well as a regional player in the agriculture-innovation process!

Peter Borring
Farmer, Chairman of the board

Per Frankelius
Process leader

P.S.
The photos on the frontpage represent some of our innovation projects.

Content

1. Organization establishment

1.1. Innovation system establishment

Agtech 2030 would not be possible – or at least not the same – without the platform that was built long time ago. Östergötland belongs to the most important agricultural regions in Northen Europe. The soils are fertile. They include stone-rich parts, heavy clay and often affected by pre summer drought, bringing challenge for spring drilling. In short the region has been perfect for need-based innovation. It is not a coincidence that Östergötland became the ground on which fantastic companies like Väderstad or Lantmännen Ethanol arose. Moreover, the landscape such as Vikbolandet has become strong in robot-based dairy-farming, and in the west and central parts of the region, almost 1/3 of all Sweden's egg production is located.

Some activities had caught attention of the outside world during the recent years before the Agtech 2030 application. Among examples are the project Fossil-Free farms project by Energifabriken initiated by AgroÖst, the formation of Vreta Kluster (also a former project at AgroÖst) or the organic profile projects at The Rural Economy and Agricultural Societies. At the university some projects had caught especial attention, e.g. the biogas research, the wildlife security project (prof. Fredrik Gustafsson) and research on poultry (prof. Per Jensen).

The project "Greenovation – New concepts for organizing user-driven innovation processes in green industries" was instrumental. It was financed by Vinnova, started in 2013 and ran until 2017. Companies such as 3M, SSAB, Biototal, Elmia, The Rural Economy and Agricultural Societies, Lovang Lantbrukskonsult, SmartPlanes, SMHI and Tolefors Farm were involved.[1] Highlights include Agriculture Innovation Day 2014 with Prince Carl Philip among participants[2], the organization of a Swedish pavilion at Agritechnica 2015, The Nordic Agri Summit 2018 organized together with Agro Sörmland and (with the Swedish Minister of Agriculture and Dr. Warren Preston, Deputy Chief Economist at the USDA and Head of The World Agricultural Outlook Board among the speakers) and the development of the Seedy experimental machine. Another project was "Dissemination of methods for high-tech agriculture" (completed in 2019) in collaboration with e.g. IBM and Lovang Lantbrukskonsult and led to a connected microscope sensor that could provide images for interpretation of IBMs AI computer Watson.


Agricultural Innovation Day 2014, the Agritechnica pavilion 2015 and the Seedy machine 2016.

Thus, both companies and the university had already been hit by the fascination of the agtech area. Efforts to mobilize actors and secure commitment around a Vinnväxt application started in December 2017 through meetings with people from Region Östergötland, Linköping University and companies. During the Spring 2018 the masterplan of Agtech 2030 formed.

Part of the discussions was based on trend analysis of world agriculture. We saw the dawn of a new technology era. This era included new crop cultivation concepts, field robotics, fossil-free energy and products, smart connected systems and animal welfare technology systems. This analysis had a positive angle. At the same time challenges were identified. World's citizens assumed by many observers to grow from 7.8 billion to 10 billion people in 2050. Because of food habits change it is truly that 50% more food must be produced in 2050. This challenge has to be

met at the same time coping with other challenges including shortage of skilled labour due to urbanization and age profile among farmers. Challenges also include tiny potential to expand agricultural land. Moreover, an agriculture need is to meet climate goals including phase out diesel. And regarding climate, farms also face more unpredictable and extreme weather conditions.

These two perspectives – technology possibilities and tough challenges – formed the basis for the commitment around the Agtech 2030 vision. One central part was to make bridges between set of actors that by tradition had not exchanged idéas and innovation energy at all – or had done it only in small scale. We identified four groups of actors: Farms, farm machinery companies, tech companies and the university. We also identified the need of other strategic actors, not least cooperative arenas. Primarily we focused on Östergötland. Based on the vision we then started to contact companies about the application. We had two goals. First, we wanted to collect and exchange ideas about needs and innovation potentials. Second, we wanted commitment and letter of intents – some hopefully also with budget indications.


Photos from our round trips in 2018 to build the partnership. Left: Father and son Johan and Markus Medin. Middle: Magnus Börjesson, Högåsa farm and AgroÖst. Right: Katarina Wiklund, The Rural Economy and Agricultural Societies.

Our 62 pages application document was filled with analyzes, visions, photos, illustrations and not least letters of intent from partners. The vision of Agtech 2030 was formulated like this in the application (short version): *"In 2030, Östergötland and adjacent areas will be one of the world's most prominent regions in agricultural technology - agtech."*[3]

It turned out that the companies more and more started to help promote the vison. Ulrik Lovang, at Lovang Lantbrukskonsult, for example stated this October 9, 2018: "We see great potential in this type of initiative being taken in our region." Regarding Linköping University we focused on these parts: The sensor fusion teams, the biology department and the hydraulics and mechatronics labs. We also engaged in student activities, for example arranging a seminar on Vreta Kluster 11 February 2018 including also researchers and company representatives.



Professor Fredrik Gustafsson discussing wildlife security, student conference 11 February and a drone vision discussed during Spring 2018 with partners.

After Agtech 2030's application was granted by Vinnova in November 2018 work started to fulfil the vision of expanded innovation system among partners. The philosophy was that relationships and mutual commitments were best created through working together, not only talking. So, we started innovation projects. The intention was to connect actors as teams in each project. That is easier said than done, and we also had to cope with the formation of the whole Agtech 2030 "infrastructure" for example decision processes, procedures for contracts, economic administration etc. Moreover, all activities needed 50/50 financial investments as a principle. Vinnova's co-

financing for Agtech 2030 amounts to during the establishment phase, ie. in the years 2019–2021, to SEK 14 million, so we needed to match this. Thanks to Region Östergötland and Linköping University we had a great starting platform, but we still needed commitments to contribute from the companies.

We will end this text with a summarizing table (Table 2) where we relate our outcome with original goals, and we will refer to this table in the coming text. To start with: With facts on hand, we know that our philosophy of *doing concrete projects as a pathway to relationships* worked. We connected aerospace Saab with the advisory company The Rural Economy and Agricultural Societies and the university to specify a new kind of agricultural machinery (cf. **Goal 4** in Table 2). We connected Tolefors farm with the company A-Electronix. We connected the GIS and satellite analysis company T-Kartor with Rotenberg Manor etc.

Only one of the original companies jumped off (XMReality) but 10 more companies joined.[4] Some of the main actors that became our actor community are listed below.

Some of the organizations that became the actor community of Agtech 2030.

There are quite many other organizations that we have worked with during the first three years, for example Swedish Farmers Federation (LRF), Biototal, Agricam and Kättestad Farm. At the same time, we must admit that we did not manage to form innovation projects with all companies on the list. One reason is simply lack of time resources.

Part of our ambition and vision according to our action plan was to establish testbeds (fr Goal **7** in Table 2). Some of the actors like Rotenberg Manor were very suitable for this. Digital platform was an Agtech 2030 project during 2020 connected with these testbeds and aiming at adapting an existing wildlife management system into a holistic farm management system. We called the strategy top-down approach – in a positive sense! First infrastructure developed and then functions were added. This top-down approach is in stark contrast to most other products on the farm market. The common approach is to develop some type of hardware, and then connect it to the cloud and develop smartphone app and computer interfaces. This leaves the farmer of a variety of tools, monitors, accounts and not the least monthly subscription fees. The digital platform is aimed to be a freeware, where hardware developers can connect their devices. The platform itself is useful for management, since it digitizes the daily workflow and documents every season. The only additional workload for the farmer, is to bring the smartphone with the app, and the simple user interface to file each activity.

1.2. Management and internal organization establishment

The plan was to form an effective internal organization to fulfil the Agtech 2030 vision. The leading star was to create an as pragmatic and simple internal organization as possible but not at the cost of not fulfilling regulations. The actor constellation was a process leading team, a steering board, support persons and a companion researcher. Moreover, we planned an "industry council". The process leading team started work as soon as the initiative took off. The team formation was the same as sent to Vinnova before we got the decision to start. The process leader Per Frankelius invited to a first process leading meeting 19 December 2018.

We discussed roles and talked in terms of "Department of the Internal Affairs" and "Department of External Affairs". Because Agtech 2030 is a consortium of many partners the "External Affairs" is not that External. We worked on risk analysis and started to plan for recruitment, the starting report, IT platforms, procedures of project management and communication. In fact we had worked on communication also during the application process (logo, colour profiles, photos etc).[5] We also formed a Nomination Committee for steering board (by help of Magnus Börjeson, Chairman of AgroÖst[6]). We also got help from Anders Carlsson at Visual Sweden. The inauguration of Agtech 2030 took place 13 Mars 2019. On 27 May was the Steering Board decided by the University Rector. At 11 June we got steering board in function.



On 13 March it was time: kick-off for Agtech 2030. There were 75 VIP people from partner companies, the region, Vinnova and the media. Jonas Brändström at Vinnova handed over the Vinnväxt prize and then was given a slide show to to the tunes of Boney M's "By the rivers of Babylon" on the theme "The road to the agriculture of the future". Professor Fredrik Gustafsson then presented a lecture on the topic Connected agriculture.

The industry council, activated January 20, 2020, consisted of the initiative's partners. Industry council meetings were held at least twice a year. At these meetings a dialogue was held about different aspects and what the way forward should look like. The purpose of the industry council is to *be* Agtech 2030. The council secures that Agtech 2030 achieves its main goal; to create benefits for the industry, and in the end the individual farmer.

The intensive years have brought learning points regarding management of complex programs like Agtech 2030. The most important one is that "persons are everything" – more important than organization charts. To create a strong and co-operative management team is very vital. In our application of Agtech 2030 we included this goal: "The initiative's implementation organization […] has been designed and implemented." See **Goal 1** in Table 2. We have finally realized that goal, even though we have been through several partly difficult periods on the way there.[7] One vital factor that made us overcome struggles is our companion researcher as well as our dialogues with experienced people at other Vinnväxt programs.

2. Results of activities and projects

2.1 Summary of three intensive years

As said, we will summarize our goal-outcome-reflections in the coming Table 2. In the following sections we summarize our first three years journey and add comments and reflections. So, Table

2 is a synthesis of this coming text. First and foremost, Agtech 2030 initiated 22 innovation projects. The total investment in these was 16,2 MSEK. We will comment on these in later section. Besides our innovation projects, however, there were also some strategic projects:

Strategic projects besides innovation projects: Some strategic projects had international dimensions, to support **Goal 2** in Table 2. Professor Fredrik Gustafsson had, during the three years, discussions with researchers at University of Pretoria and University of Johannesburg regarding new technologies for an area that we have found synergies with: wildlife protection. They explored sophisticated sensor solutions from the military sector and have tested them on the savannah. All involved are members of the International Society of Information Fusion (ISIF), and a proposal was submitted to form a working group within ISIF on animal welfare and protection.[8]

Another example: Satellite images are getting better and better resolution. One unexpected application of high-resolution images was to perform census of elephants automatically. Olga Isupova, a former PhD student in an EU project where Linköping University was one node, co-authored a paper with Fredrik. An initiative was taken to explore possibilities to detect and count smaller animals. It is still expensive and hard to access the best 3dm resolution images, so this collaboration is on hold for the moment. Possible application cases are to count rhinos and reindeers and their positions and we saw potential of this in agriculture.

There are more examples: We here give examples from 2019, 2020 and 2021:

2019

Representatives of Agtech 2030 gave a presentation in March 2019 during a conference in Florence, Tuscany, led by The European Region for Innovation in Agriculture, Food and Forestry (ERIAFF) within the framework of the focus area High Tech Farming. The aim was to prepare for international cooperation with other agtech platforms. In April, we got visited by a delegation from the Royal Swedish Academy of Forestry and Agriculture (KSLA) - with i.a. lecture on Agtech 2030. Because KSLA is an important neutral academic platform for the green sectors in Sweden it was motivated to connect with KSLA. In May in Västervik occured Final demonstration in Vinnova's drone call; Fredrik Gustafsson and Jonatan Olofsson demonstrated drones with multiple radio scanners.

In June, we participated in an ERFA meeting for Vinnväxt, in Örnsköldsvik arranged by Vinnova.[9] We also made a study visit to Processum and the Biorefinery of the Future. The aim was to exchange experiences with other Vinnväxt platforms.

In August, a group of people met at The Rural Economy and Agricultural Societies Skåne at Borgeby Castle to discuss new ways of analyzing soils and crops with sensors and artificial intelligence.[10] Later this led to project cooperation and an approval of that project (ca 7 MSek).

On 13 November we arranged an idea meeting between Agtech 2030 and Agroväst, which is a similar innovation platform but in Västergötland. That was a kick-off for the project ”Smart Agtech, a strengthened innovation system for new technology in agriculture” (that got funding by Swedish Growth Agency).



The meeting in Borgeby, ERFA meeting in Örnsköldsvik and drone demo in Västervik.

It has been a dream to connect with top agtech companies on the international scene. During the Agritechnica fair in Hannover, Germany, 2019, we arranged a discussion meeting with a team

from John Deere. Part of the background was an international seminar with John Deere in September 2019 organized in Linköping.

In October we had a demonstration of the robot system Fieldgofer at Abbotnäs Manor. The organizer was our partner AgroÖst and their project Agro Sörmland. The project that had led to Fieldgofer was a collaboration between farmers, technology experts and innovation support actors. We also established cooperative projects with Kolmården Zoo during October.



Meeting with Agroväst, meeting with John Deere and congratulations to our partner company Väderstad who received silver medal for the Wide-lining concept – all during Agritechnica in Hannover 2019.

2020

We have in various ways collaborated with the Vreta education center. In October 2020, in connection with a test run of plows, we did experiments with a machine prototype. In October, we arranged an activity day at Tolefors farm to discuss cooperation in sensor infrastructure and ammonia sensors for polutry.[11]

In November we announced the new education "Agricultural Technology and Innovation", 3 academic credits. It was with pride and joy that we could see our university go out with the news of the new education.

Also in November, we received approval for the Vinnova project Agriculture and AI in the service of climate, a project in collaboration between The Rural Economy and Agricultural Societies, Lund University, the company T-Kartor and Linköping University. The project budget is approximately SEK 7 million. In December, we received the application Granted by Vinnova for Drones for a safer society - with a budget of SEK 1 million.



Test activity of a prototype at Vreta Education Center, discussion around poultry sensors at Tolefors, and flyer for our new university course Agriculture technology and innovation.

2021

Among new projects in 2021 are these: In May, the inaugural meeting for the "Experience Center for Food" run by Mjölby Municipality, a grand vision in the form of a knowledge and experience arena of over 35 hectares outside Väderstad village – partly inspired by a center in the Netherlands.

In October, we participated in The Connector 2021 organized by Business Sweden with a focus on Israel. In December, we had industry advice within Agtech 2030 at Vreta Kluster. Also in December, we participated in the final seminar for test bed digitalized agriculture in Uppsala - an initiative with which we have collaborated a lot and made plans.

Still more in December: We also arranged a report release at KSLA during the seminar "Technology in soil and forest - time for national gathering of strength!" in Stockholm. The process leader of Agtech 2030 had been chairman of KSLA's technology committee, which had

been running for 3 years. Before December ended we submitted a tender for the procurement of "Preliminary study Knowledge Hub Digitization" from the Swedish Board of Agriculture.

Knowledge development, analysis of the surrounding world and dissemination: Communication is a two-way process. We don't want just to inform about what we are doing. More important is listen and learn from others. Agtech 2030 has put in substantial efforts in communication – and knowledge development. Already in November 2018, During the Elmia Sub Contractor trade fair, we met with researchers from the Frauenhofer Institute in Germany who have developed new composites made from hemp, e.g. a wing for competition version of Tesla made of composite material based on the renewable agricultural product hemp. This brought information and ideas to Agtech 2030 that can be seen in the light of the fact that Region Östergötland has "innovative materials" as one of the specialization areas. The coming years became very intensive.

2019

In January 2019, we had a theme day about sheep farming at Fågelberg farm. We knew that the sheep industry has great need of innovation but at the same time suffers from lack of resources in relation to dairy industry for example. The seminar was a way to bring more knowledge on this into the Agtech 2030 organization. In February, the process leader of Agtech 2030 was the moderator for the conference "Materials without borders" at the inauguration of Innovative Materials Arena, IMA in Linköping. Keynote was Professor Maria Strömme, researcher in nanotechnology. This was also a way to connect with the material perspective. Also in February, Agtech 2030 participated in an international conference: "Photonics in Agriculture and Food" in Amsterdam organized by Wageningen University. Per Frankelius gave a lecture entitled "Realizing photonics innovation in agriculture: A matter of marketing?" and initiated a cooperation project with Guus Taminiau, one of the founders av Photonics Netherlands. In connection with this Agtech 2030 also connected with Prof. Hugo Thienpont, the Coordinator of PhotonHub Europe initiative and wrote a letter of cooperation. Cf Goal **15** in Table 2.

In March, Agtech 2030 participated in an International Agricultural Conference Lithuania organized by Romas Naudziunas at UAB Väderstad in Lithuania. Among the 350 participants was Europe's largest organic farming company, AUGA Group, which cultivates 45,000 hectares. Per Frankelius gave a speech on the agriculture of the future. It was natural to say yes to this invitation because the mother company to UAB Väderstad is one of Agtech 2030s main partners.

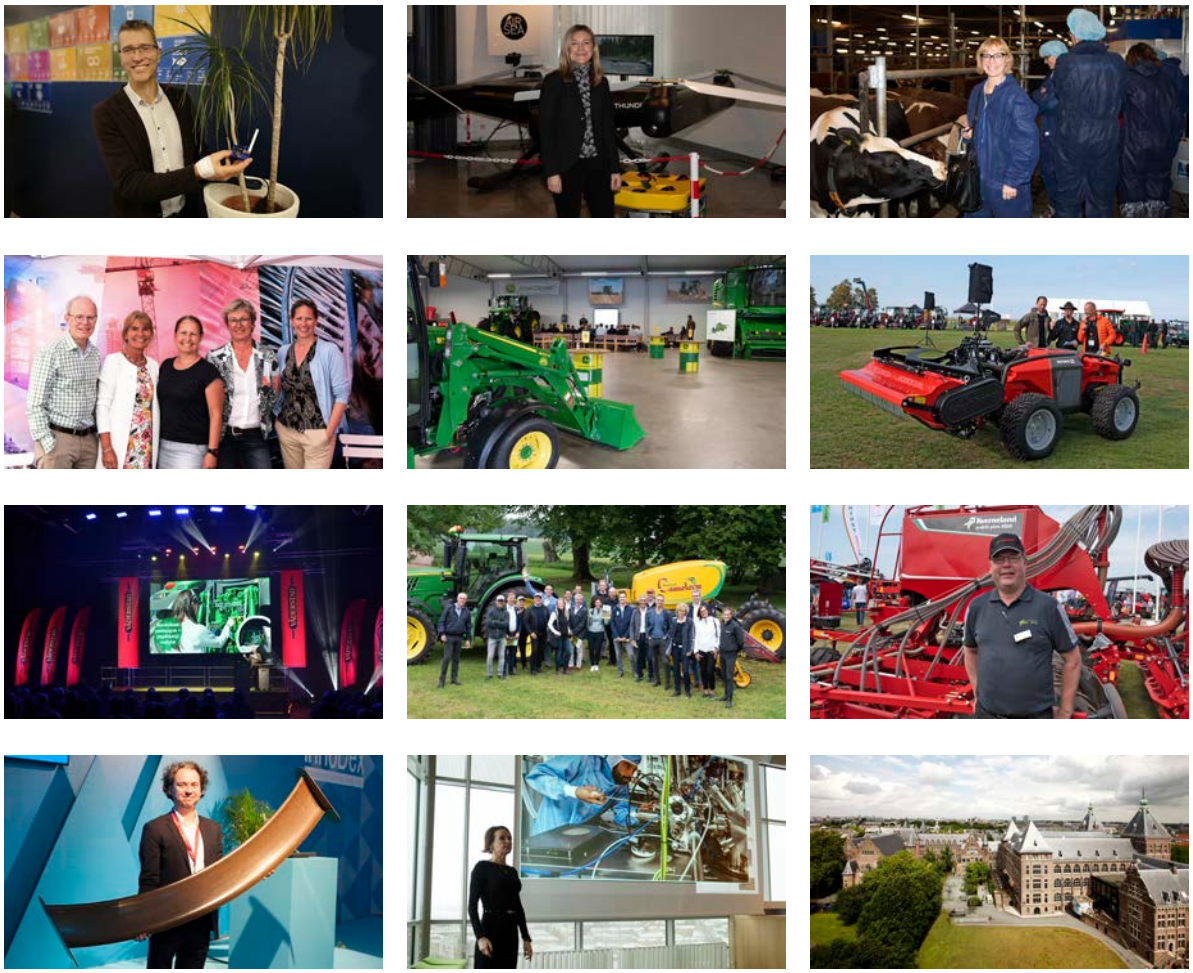
The hydraulics days in June at Linköping University were arranged by Petter Krus, Professor of Fluid and Mechatronic Systems. Magnus Landberg at Saab and Per Frankelius participated. The aim was to prepare for cooperation with experterts in mechatronics and hydraulics. Later this turned out to be very fruitful as it led to the Flexrow machine. Cf **Goal 3** in Table 2.

In June, a Food Valley delegation visited Östergötland. Agtech 2030 arranged seminars and visits at Tolefors Farm and Väderstad. Many reasons motivated this involvement. Food Valley is very innovative and we looked for cooperation areas. Moreover these actors have a cooperation agreement with the region Östergötland. Also in June we exhibited at Borgeby Field Days and also arranged an international seminar on irrigation. Smart irrigation was seen as an interesting potential area to engage in, and two of our partner companies (Rotenberg and Medin Machine) had communicated this interest.

In July we were on site at Almedalen (yearly big Swedish political and lobbying event) when we, together with East Sweden, had a seminar on Robots, sensors and satellites in agriculture. In September, we gave a lecture at the Food Days in Tylösand. The motivation for this event was that we wanted to expand our understanding on food systems and food chains from primary producer's perspective. Also in September we attended the Elmia Garden and Elmia Park Exhibitions. We thought the technology here, radio-controlled tractors for example, might be interesting also for farmers.

In October, we made a study visit to the Royal Riding School in Strömsholm, to understand more about horse-related innovation needs. We also gave a lecture at the Business Economics Congress (in Gävle) about green sector business models. Moreover, we were invited to the Future Forum with Swedish Farmers Federation at the National Museum in Stockholm.

In November, we participated in Sensor Day at Science Park Mjärdevi and UAS Forum 2019. The mission here was partly to demonstrate Fredrik Gustafssons ideas in sensor fusion. And in December, we were invited to the inauguration of a new milking system in Lövsta, arranged by SLU and DeLaval. This was a shortcut to leading expertise in dairy innovation systems.



National and international activities during our first year (2019).

2020

One strategic project during 2020 was to start planning for an European Digital Innovation Hub focused on agriculture, Agrihub Sweden. In may we joined Matchmaking for EDIH hubs with Vinnova. The planning of this EU application and ended up in a submission in February 2022. The EDIH initiative brought together established organizations around this vision: to transform the Swedish agrifood system into a world class example in achieving sustainability and competitiveness through digitalization. Agrihub Sweden was a cooperation project including Agtech 2030, RISE (Research Institutes of Sweden), Swedish University of Agricultural Sciences (SLU), Visual Sweden (c/o Linköping University), Agroväst and Krinova (Skåne). Cf. Goal **11**. But more happened:

In January we were at The Academy of Forestry and Agriculture's festive gathering in Stockholm City Hall. In February 2020, just before the corona restrictions took effect, Agtech 2030

organized an international conference with students and businesses at Vreta Kluster on the theme Developing future food through customer understanding and smart marketing.

In February, we gathered at Lövsta Gård on Gotland for a national conference that attracted about 200 visitors. In June, we arranged the seminar ”Smart agtech reduces our vulnerability” and an exhibition under Elmiadalen. In August Agtech 2030 had the honor of participating in an exclusive demonstration of John Deere's upcoming X9 combine.



Student seminar arranged by Linköping University and Vreta Kluster, KSLA meeting and Elmia Innovation Award.



Elmiadalen, test demostration of the X9 cobine and pod-production in the University workshop with LRF.

In August, we also participated digitally in an American International Conference in the United States organized by Pipestone, where the process leader gave his view on agriculture and the climate. In September, we had a Pod recording with LRF in the university's workshop to showcase our construction of a new machine concept with flight technology (with Saab). On September 22, we had visits from ambassadors from 19 countries and offered the world premiere of Flexrow, a collaboration between Saab Ventures, The Rural Economy and Agricultural Societies and Linköping University. In October, prizes were also awarded within the Elmia Innovation Award with the process leader of Agtech 2030 as a member of the jury.

2021

In February 2021, Per Frankelius and Matilda von Rosen were invited to speak at a conference hosted by the Morley Agricultural Foundation in England. The same month we lectured at the Norwegian company Yara's 20th anniversary for the N-sensor. We also did a case study of it – together with Yara. We also participated in the international animal fair Eurotier. In March, we made a film about innovation for the Swedish Board of Agriculture and participated in the Lantmännen Research Foundation's foundation day in 2021. In April, our recordings of films for an upcoming exhibition started. We participated as lecturers during the Inauguration of “The Future Farm Bjertorp”. Furthermore, we recorded a podcast for LRF at Vreta education center (among the cows in the barn). In May, we participated in the Biofertilizer Day and had previously recorded a film about Sverker Peterson from Bjälbo Farm. In May, we lectured at an international conference on photonics. 112 people from 12 countries participated.

In June, it was time for Borgeby Field Days, which due to the pandemic was a digital fair this year. Agtech 2030 was involved in several of the 15 innovation projects that exhibited with films, photos, texts, chat, etc. In August, we lectured on innovations during the final conference for Natural Pasture Meat from Östergötland. It took place in a barn on Tinnerö. In September, we had a visit from EU parliamentarian Emma Wiesner & Co and participated in visits to Väderstad, Hermelin's Vegetables and Blackert Agriculture. The same month, we participated in the

premiere of a world novelty, the fossil-free methane tractor New Holland Methane Power, in Vimmerby. There we also gave a lecture on Agtech 2030. In September, Linnéa Stark and Per Frankelius also recorded a podcast for Prevent.

On October 14, it was time for the conference "A step towards climate-neutral agriculture" which took place at Naturbruksskolan Uddetorp in Västergötland. The process leader gave the lecture before the machine demonstration. In October, we also participated in Smart Farming at Taxinge Castle. The organizer was Agro Sörmland, which is part of AgroÖst and also a partner within Agtech 2030. Ulrik Lovang was the moderator. On 17 November, Agtech 2030 participated in Sheep's Day in the Swedish Parliament. In November, we presented a report at SLU Alnarp in Skåne. In November, we co-organized the international conference Photonics 4 agriculture and food, in Norrköping (together with PhotinicSweden and Visual Sweden). The year ended with a Christmas seminar on fossil-free machines at Vreta Kluster.



Visit at the farmer Sverker Peterson from Bjälbo, Seminar during Borgeby Field Days and premiere of New Holland Methane Power, in Vimmerby.

Patents, prizes and awards: Agtech 2030 partners like Kverneland, Gothia Redskap, Saab and Väderstad have always patent projects ongoing. But also some of the Agtech 2030 management team have developed ideas that ended up in patents. These include "A method and system for monitoring rhinoceroses" (2019), a robot concept (2020) and soil compaction indicator (2020).

In October, it was final of the Agtech Challenge, where some of Agtech 2030's partners participated – in 3 of the 15 competitor teams: Flexrow, Fieldgofer 2.0, Solkol and Agrosolary. Team Flexrow got recognition for "best innovation height" and team Fieldgofer 2.0 won second prize in the People's Voice category.[12] Also in October Per Frankelius got the Hagdahl Prize from the hand of the Governor of Östergötland, Carl-Fredrik Graf.[13]

The most sensational prize, however, was that Agtech 2030 won silver medal in Agritechnica Innovation Award for the Compaction Prevention System invention.

Media impact: During 2019 was published more than 100 articles, radio sections and TV-news about Agtech 2030. It was fantastic to see the response from agricultural press and national press. Another media example was the "Running Help" project (Springhjälpen) by Swedish Television. The process leader of Agtech 2030 was put in a rolling studio to talk about agriculture – and then had to run behind the bus 7 km.


TV-program Springhjälpen, Article in Land Lantbruk about space technology (built on research in Agtech 2030) and tv-program about sensors from our exhibition at Borgeby Fielddays (all during 2019).

During 2020 the media impact just expanded. There are countless of articles, TV-reportages and radio programs that higlighted Agtech 2030, for example Swedish Radio P4. Almost all Swedish trade journals in agriculture wrote about our activities in 2020. Examples are Land Lantbruk, Jordbruksaktuellt, Lantbrukets Affärer, Lantmannen and ATL. We also had an international impact. The launch of the Flexrow machine concept generated articles in about 20 countries.[14]

In 2021 more than 50 articles were written in different media, e.g. Ny Teknik, Land Lantbruk, ATL, Lantbrukets Affärer, GöteborgsPosten and Gröna Affärer. Media included international media. In January the prestigious Farmers Weekly in England published an article about our innovation project Flexrow and feedback flowed in from several countries. The background was dialogues in the autumn of 2020 and that the journalist Edward Mowbray visited us the week before Christmas - a visit that, however, came to an end due to the corona restrictions. Also, in January Eastern Daily Press in UK wrote the article "Norfolk farmers offered Swedish insights into climate challenges" because of our participation in a UK Conference arranged by Morely Agricultural Foundation. In July we were happy to see an article in renowned Profi about the patented invention "Non-stop battery-powered concept". We were also happy that SLU in their magazine wrote the article "The future is already here - Artificial intelligence in agriculture" about our exhibition on future farms that we had during the summer.

Two international and one Swedish article about our innovation projects in 2021.

Regarding TV it was a reportage in TV4 News in July sent from Karola Reuterström's farm (Karola is member of the board of Agtech 2030). Some web-based tv-events had also broad impact. One example was SEB Talks (the bank) in October 2021.

TV reportage in TV4, Swedish Television and the bank web tv "SEB Talks", all in 2021.

2.2 Innovative capacity among Agtech 2030s partners

In our goal pallet (Table 2) was not any on-spot goal regarding innovation capacity, which itself is a learning point to bring for the next phase of Agtech 2030). But Goals **3**, **5** and **6** are adjacent. The innovative capacity among partners has expanded in three ways through Agtech 2030. First, we have connected actors in teams that have conduct innovation projects. Second, we have contributed with financial resources for these projects (all projects in table 1). Third, we have conducted (and invested financial resources in) seminars, conferences, trade fair activities that have moved dialogue forward regarding innovation needs, innovation potential and ideas. That in turn add innovative energy for partners.

On the other side, we have had some problems with efforts to expand capacity. In one case the company we worked with got a new CEO and that person had the philosophy not to engage

too much in innovation system cooperation. Some examples of our innovation projects are presented in Table 1.

Table 1. Innovation projects supported by Agtech 2030 the first 3 years. For abbreviations see note.[15]

Project	Theme	Team	Start
High-efficiency and flexible actuator for agricultural machinery (Flexrow)	Machine (seeders)	Saab, HS, LiU IEI	2019
Precision Cultivation 2.0 (Spectral Signatures)	Crop	HS, T-kartor, LiU	2019
Pre-study, Wild animals	Animals	LiU-IFM (Lovang)	2020
Pre-study, Fertilizer	Animals and crops	LiU-IFM (Lovang)	2020
Digital platform	Infrastructure	LiU-ISY, HiQ	2020
Rapeseed beetles	Insects	Lovang, LiU, SFO	2020
Physical environments that promote innovative processes	Innovation management methods	House By Stark, Väderstad, LiU	2020
Increased value added in the starch market	Grain products	Lantmännen, LiU	2020
Demountable with flight technology	Machine (trailler)	Saab, Metsjö, GN Tech	2020
Establishment strategies for cereal crops	Machine and Crop (seeder)	Väderstad, Lovang, HS, LiU	2020
Digital bee partner	Insects and Crops	LiU, HiQ	2020
Respiratory sensor	Animals (Cows)	Saab (SLU, Kättestad, DeLaval)	2020
From grassroots idea to innovation idea	Innovation management	AgroÖst, Vreta Kluster, LiU	2020
Test bed Tolefors	Machine, Grain drying, Poultry and Crop	Tolek, LiU (ISY)	2021
Technology for smarter plant cultivation	Crop	HS, LiU, T-Kartor	2021
Secure digitization	Digital systems	LiSP, LiU	2021
Technical assistance at a distance	Machine	Gothia Redskap, A-Electronix, Tolek	2021
AI individual analysis	Animals (Pigs)	Smart Agritech Solutions, LiU	2021
Future technology for better decision support	Crop and Machines	Åhmans, Kverneland, LiU (ISY, IEI)	2021
Ecoweb	Animals (game)	Lutra Interactive, LiU (IFM), Visual Sweden	2021
Gender determination of egg	Animals (Poultry)	Dansic, LiU-SAS	2022
Technology park as a resource	Innovation management	LiSP, LiU-ISY, VK	2022

Let us mention some examples with our **Goal 3** (Table 2) in mind. In the project High-efficiency and flexible actuator for agricultural machinery (HILA) the aerospace company Saab improved its capacity. The project leader Magnus Landberg at Saab commented: “By help of Agtech 2030 we could start cooperation with The Rural Economy and Agricultural Societies and Linköping University and that helped us to define product concepts, including give up some early ideas that did not turn out to be fruitful”.

Another example is the Rapeseed beetles’ project. Lovang Lantbrukskonsult (advisor) connected with biology experts and sensor fusion experts at the university (cf. Goal **9**). Moreover, the team connected with Sweden's Seed and Oil Plant Growers. This led to a competence profile including biology, technology and farm user needs.

Still another example is the project “Technical assistance at a distance”. Here the machinery company Gothia Redskap joined with the company A-Electronix, the end user test pilot Tolefors and Linköping University to specify new innovative concepts for remote service and remote support. From each of these players the project meant expanded capacity.

The project “Establishment strategies for cereal crops” was conducted through a team consisting of Väderstad, Lovang Lantbrukskonsult, The Rural Economy and Agricultural Societies and Linköping University. It meant capacity extension for all partners. The project leader Björn Jeanson at Väderstad verified this: “The project included field test of new machine concepts and contributed to the design of next generation seeding machines.” (cf. Goal **6**)

Glimpses from the project ”Establishment strategies for cereal crops” which according to Björn Jeanson contributed to the new generation of seed drills at Väderstad. Notice the aluminum ruler – an example of concrete product development.

In the Respiratory sensor project, Agtech 2030 became a hub for cooperation between Saab, Linköping University, Swedish University of Agricultural Sciences (SLU) and farms. It led to proof of concept regarding visual sensors as detectors of animal breathing in stables.

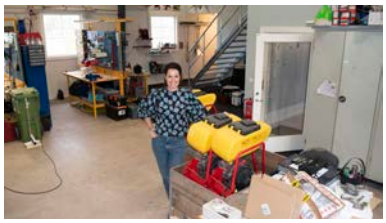
In the project “AI individual analysis” Agtech 2030 made a bridge between the agtech company Smart Agritech Solutions and Computer Vision Laboratory at Linköping University. This project is still ongoing, but indications show that it might be possible to detect individuals among pigs by means of AI-aided image analysis.

The project “Gender determination of egg” was based on a cooperative team of the company Dansic, Linköping University and Agroväst. Thanks to the cooperative platform Smart Agtech (between Agtech 2030 and SmartAgri in Västra Götaland) this project got capacity extension that led to funding support as well as resources for a robot prototype in egg analysis handling.

2.3 Methods and processes among Agtech 2030s partners

We have already in the section above tried to describe the innovation system efforts in relation to concrete innovation projects. The leading star of our initiative is learning by doing. There are also some of our projects that focus on innovation management *per se* (cf. goal **4** in Table 2). One of these is the “From grassroots idea to innovation idea” project. In that project, platforms were created for the development of innovations based on problems, needs or proposals for smart solutions that originate from people in the professional reality of agriculture.[16] One of the methods used by the innovation leaders was developed by Åsa Öberg and Roberto Verganti.[17]

Another project focusing on innovation management methods was “Physical environments that promote innovative processes”. Based on the human need for stimuli to perform innovative concepts, this project concretized a number of criteria on physical environments to support innovative processes. The method included studies of agtech-related environments that we knew in the end have generated innovation - but also environments from other sectors. Examples of concepts we used in the analysis were moodboard and neurodesign.[18] The project was a collaboration between House by Stark, Väderstad, Sankt Kors Fastighets, Linköping University and Crearum. This led to an experimental platform that included a new room with fully adapted content based on the need to support innovative processes. The room was established next door to a prototype workshop in Väderstad.



Linnéa Stark during the creation of Idea Lab, an innovation room as part of the project "Physical environments that promote innovative processes".

What these mentioned projects have in common is that they increase the organizations' innovative ability and capacity. The projects we mentioned here are completely dedicated to developing innovation methods, but other projects also bring with them increased knowledge of methods for innovation as the projects are largely about inspiring companies to open innovation.

2.4 Regional and national R&D impact

It has been some "R" during the first years, which is mirrored in our scientific publications including articles in renowned journals as well as books chapters.

2019 During 2019, Agtech 2030 members produced 14 research articles (peer review), two book chapters, 8 conference papers, 8 other (popular science) publications and 9 debate articles (cf. Goal **14**). Some examples: In the article "Agricultural Innovation and the Role of Institutions: Lessons from the Game of Drones" (Journal of Agricultural and Environmental Ethics) was presented a study on how drones can help agriculture in different ways. In the article "Innovation is to utilize something new and useful (Swedish medical journal) was a study on security cabins in agriculture. In the article "Identifying the resource integration processes of green service" (Journal of Service Management) was discussed how the green sector can add values to nature. The article "Revisiting Industrial Organization: Product Service Systems Insight" (Journal of Cleaner Production) discussed how agriculture can add value to nature. The article "Back to the root causes of war: food shortages" (The Lancet) included an analysis on how agriculture is related to social welfare.

2020 In 2020 Agtech 2030 reported 2 research articles (peer review), 3 conference papers and 5 reports. One article, in International Food and Agribusiness Management Review, focused on the role of innovation intermediary organizations in forming value creating meetings. Another, in Agronomy Journal provided an analysis and a proposal to rethink agriculture in the climate calculations. Among the reports one was a 15 hp thesis on the Potential of starch (in cooperation between supervisors at Linköping University and SLU). The report "Face recognition of horses using convolutional neural network" was about AI and based on image collecting at Hollstad farm.

2021 In 2021 the publication list included 2 research articles (peer review), 1 other research publication (without peer review), 4 popular science articles, 2 international book chapters, 2 student theses and 3 reports. Some examples: One research article (IEEE Sensors Journal) was about synchronous Averaging of Gait Cycles for Classification of Gait and Device Modes. One book chapter had the title "Energy Solutions for Agricultural Machinery – From the Oil Era Towards a Sustainable Bioeconomy" published by Springer-Nature, and the other was submitted and had title "Towards the fifth agricultural innovation era" (Elsevier). The popular magazines included Farmers Weekly and Arvensis.

We think our research has had some impact both nationally and internationally. Regarding The Lancet (impact factor 53) it was the third most influential scientific journal according to Clarivate Analytics. But we know that we could have had much more connections with researchers in Linköping University. The plan is to expand that (see Appendix 1).

We have also been active in scientific conferences like 30th world conference 2020 ”Food for the future” (Rotterdam), “Babson College Entrepreneurship Research Conference” and “International Conference on Information Fusion” (South Africa). Have this had any regional and national impact? We think it might have had some impact. There are hundreds of trade and national press articles referring to our research. We have been invited to countless conferences and meetings to present our research. One of us was ranked as one in Land Lantbruk’s list of the 50 most influential persons during 2020.[19] The Natural History museum arranged an exhibition in 2021 about wildlife security where Agtech 2030:s sensor concepts was part.

Above we have discussed the “R” in “R&D”. We think that most impact has to do with the “D”. The list of our innovation projects may indicate the D impact.

However, we are not satisfied with our efforts to stimulate new technology start-up companies. Nor have we succeeded in inward investments, meaning attracting agtech companies in other parts of the world to established business in Östergötland. We have made an analysis on this. The main reason why we have failed in these aspects is probably that we focused on the formal partner, and they were established companies in our region.

2.5 Impact on regional and national strategies

We have tried to connect with the regional strategy work. Some examples: In April 2019, we participated in a meeting on the regional food strategy at the County Administrative Board of Östergötland. Two of us are part of the strategy group for the regional food strategy. The meeting was chaired by our new Governor Carl Fredrik Graf. Cf. Goal **13** in Table 2.

In March, 2021 we had Kickoff for the strength area “Smart, safe and robust connected products and systems”.[20] In May, we participated in the ESIN meeting, a regional forum on the region's areas of strength. We did an analysis of how Agtech 2030 is docking against the region's strengths. Roadmaps for regional areas of strength were then (October) decided in a workshop.

Vreta Kluster is responsible for the food strategy implementation, and we are all very active in regional dialogues of different kinds (cf. Goal **13**). Martin Tollén at Region Östergötland is member of our steering board. In August 2021 was a meeting between Agtech 2030 and Region Östergötland. The meeting was attended by both politicians and officials.[21] In October, a conference was held within the East Sweden Innovation Network (formerly IKG). Östergötland's innovation environments gather continuously to exchange ideas and forge collaborations. This time there were i.a. EDIH on the agenda and Per Frankelius presented the visions of Agrihub Sweden. Also from the region were Anna Jacobsson and Malin Thunborg. Cf Goal **12** in Table 2.

Through a series of workshops on the theme of smart specialization led by Niklas Tideklev at Region Östergötland, regional actors on 28 October 2021 were able to land in a description of roadmaps for selected areas of strength, namely advanced materials, efficient logistics, environmental benefits such as business, visualization, simulation and image analysis and smart, secure and robust connected products and systems. Agriculture and operations within Agtech 2030 are linked to all these areas of strength and it should be emphasized that ”the food supply of the future” is a priority challenge area within the ÖMS region (East Central Sweden where Östergötland is included). On November 10, Agtech 2030, through process leader Per Frankelius, presented the situation and future picture for Agtech 2030 as part of the basis for the region's decision on continued financing. In the minutes, we were pleased to read the following: “The Regional Development Committee DECIDES to extend the project period until 2022-09-30, and to increase the co-financing during 2022 by allocating SEK 803,410 from the state grant 1: 1 Regional growth measures. Otherwise, the same conditions apply as before.” Cf. Goal **12**.

We have also been active in national strategies. Some examples: In October 2020, AgTech 2020 was arranged with 250 participants coordinated by AgTech Norway in collaboration with Agtech 2030 and RISE. Among the speakers were the Norwegian Minister of Agriculture, the

City of Olaug Bolle, the Swedish Minister of Rural Affairs, Jennie Nilsson and Jonas Engström, RISE and Per Frankelius, Agtech 2030.

In December 2020, the Swedish Agency for Economic and Regional Growth and the Swedish Board of Agriculture arranged a conference on the Swedish food strategy. Among the speakers were Jennie Nilsson (Minister of Rural Affairs), Christina Nordin (Director General of the Swedish Board of Agriculture) and Gunilla Nordlöf (Director General of the Swedish Agency for Economic and Regional Growth) and Per Frankelius (Linköping University).

In February 2021, the process leader of Agtech 2030 was approved by the IPCC as "expert reviewer".[22] In the spring of 2021, he was elected to an expert group formed by KSLA, called the Climate Group. In December 2021 the process leader was entrusted by Linköping University to act as a reference body for the public inquiry "The road to fossil-independent agriculture (SOU 2021: 67)".[23] All these examples support Goal **12** in Table 2.

3. Agtech 2030 as driver of sustainable innovations

Agtech 2030 focuses on developing agriculture and its food production through innovations in a way that meets several sustainability goals. Goal conflicts exist and innovation is needed.

The Objective that connects most to Agtech 2030 is **Objective 2**, "No hunger". The world's population is expected to grow to 10 billion in 2050. Due to changed eating habits, the forecast is that 50% more food must be produced by 2050. This calls for innovations and Agtech 2030 clearly contributes to such. As food as well as water and energy are essential for people, cheap food is also a way to support **Objective 1** "No poverty".

Agtech 2030 has obvious connection to **Objective 9**, "Sustainable industry, innovations and infrastructure". This is the core of Agtech 2030's operations.

A lot of new technology is about stimulating natural grazing animals. Such technology supports **Objective 15** "Ecosystems and Biodiversity". In the yearly meat guide from WWF the only meat that got green light was from freely grazing cows. Agtech 2030 initiated a project already to support owners and carers of grazing cows with technical support. The project is a mirror of the Ngulia project in Kenya for rhino welfare. The management system for park rangers was adapted to Swedish farmers, so they can document their daily monitoring regulated by law.[24]

Regarding the sub-goal "stop and turn back soil destruction", Agtech 2030 received international recognition. To celebrate Earth Day 2021, the American Society of Agronomy[25] highlighted Per Frankelius' article "A proposal to rethink agriculture in the climate calculations". The article was made freely available for 30 days. Moreover, the concept "Compaction Prevention System" is about reducing soil compaction and strengthening soil health.

Agriculture is unique because it not only generates emissions of negative greenhouse gases but also generates "inlet" of carbon dioxide through photosynthesis. Agtech 2030 conducts research on innovations that can reduce emissions, but also innovations that can increase carbon sequestration in soil and substitute fossil products with nature-based ones. Therefore, Agtech 2030 contributes in several ways to **Objective 13** "Combating climate change".

In addition to the mentioned sustainability objectives, Agtech 2030 contributes to Objective **5**, "Gender equality". Agriculture is traditionally a male-dominated industry. Furthermore, it is traditionally divided so that more women are in parts connected to animals, while men to a greater extent tend to be in crop production. It is therefore important to identify innovation projects that link to the livestock part of agriculture, as we to a greater extent reach the industry's active women there. We have several successful projects, but need more. Agtech 2030 has actively worked to reduce this dominance. This was done, for example, through targeted recruitment initiatives for the course Agricultural Technology and Innovation (result: 15 women, 27 men, which was beyond expectations). We need to do much more. Cf. Goal **16** in Table 2.

Agtech 2030 also contributes to **Objective 8**, "Decent working conditions and economic growth" and we are thinking here of all those who work in the green sector. Innovations can often improve the working environment (we wrote an article on that in Swedish Medical Journal) and also contribute to a stronger economic development of agricultural activities. Even today, agriculture is an accident-prone industry that has difficulty recruiting labor and profitability is not on par with the development and investment needs in many agricultural companies.

Regarding **Objective 12**, "Sustainable consumption and production", Agtech 2030 contributes to innovative methods that make the production of agricultural products more efficient and more environmentally friendly.

Finally, not least the sad war crisis in Ukraine motivates us to mention **Objective 16**, "Peaceful and inclusive societies". One of our articles demonstrated the link between the availability of food and world conflicts (The Lancet). Efficient food production is a peace-keeping factor and innovations that develop food production thus have a social value.

In practice we contribute to the objectives by innovation projects and by other activities. The project "Ecoweb", for example, addresses the issues by means of creating an innovative game to understand biodiversity on farms. That project is conducted by the Lutra and Linköping University together with farmers. The project "Digital bee partner" aimed at developing sensor technology for promoting pollination, at the same time create more honey. That was a cooperation between Linköping University, HiQ as well as a bee company and farmers.

We are also cooperating with other platforms in Sweden with sustainable goals as guiding star. In November 2020 the research financier FORMAS decided to fund SEK 48 million to "SustAinimal - a collaborative research center exploring the future role of livestock in sustainable and competitive Swedish food production systems". The main applicant is SLU and the zealot behind it is Professor Sigrid Agenäs. Agtech 2030 (via Linköping University) is a partner in this as well as Vreta Kluster which is part of Agtech 2030.[26] Compare our Goal **11** in Table 2.

4. Unexpected results and effects

The unexpected things that happened were both of positive and negative kind. One negative result was the cultural friction that sometimes appeared between some parts of the University and some parts of our business environment. There are also examples on how intentions in our innovation projects turned out not to be plausible. Some innovative ideas simply did not work out.[27] But if we turn to more positive unexpected results and effects, these are some examples:

During the first year we witnessed so much response that we were almost chocked. As soon as Agtech 2030 had been established, for example, we were contacted by The Federation of Swedish Farmers. They wanted to work with us. This led to a large joint conference in April 2020 at Linköping's Concert and Congress. It was an intense day spiced with technology demonstrations from the research team around Professor Fredrik Gustafsson and Sensefarm. We also got new contacts, for example Robin Teigland, Professor of Management of Digitalization at Chalmers.

The conference "Think again" in cooperation with LRF, The Federation of Swedish Farmers.

One unexpected thing happened in the project Digital platform. The project was based on a concept developed in project Ngulia in collaboration with park rangers and officers within the Kenya Wildlife Service. The platform consists of a user App that digitizes the park guards' daily work and a Dashboard that compiles reports from guards and sensors in the field. The technical part (backend) consists of a cloud-based database and various interfaces for receiving and disseminating information to clients. The project was about adapting *to* the agtech area. It was about modularizing the entire platform so that it could be adapted to a number of different areas of use. It also led to applications such as poultry (Tolefors), vessel moisture analyzes (Rotenberg), technology for analysis of rapeseed beetles (Rotenberg, etc.), plant monitoring (Fylla, Annelund). The unexpected thing about the project was that ideas arose to contribute ideas also *from* the agricultural area *to* the area of wildlife security. For example, soil moisture sensors were placed on the savannas of Kenya and soil samples were analyzed using agricultural methods (April 2021).

Within the framework of Agtech 2030, Linköping University developed a commissioned training course called “Agricultural Technology and Innovation” which was carried out in the spring of 2021 and gave 3 academic credits. The concept was unique in its kind and we invested extensive resources in planning. Two unexpected things happened. First, we were amazed at the positive response. As many as 42 participants (15 women) from the business community signed up, and this should be seen in the light of the fact that the course cost SEK 6,500 for them. Secondly, there was the Corona Pandemic, which changed the conditions. Having meetings in peace and quiet where you have an intense and personal dialogue between 42 sharp people was something we really wanted to achieve with the course. Instead, we had to hold the course digitally at a distance. We therefore invested in video reporting as an alternative to study visits.

Another example of unexpected things was that our invention Compaction Prevention System (CPS).[28] It was amazing that CPS won a silver medal in the Agritechnica Innovation Award, which is one of the most influential prizes in global agtech industry. The team behind CPA consists of two farmers (Tolefors and Elvestad Södergård), the agronomy advisor Lovang Lantbrukskonsult, one researcher (at Linköping University) and five engineering students.

Soil moisture sensors in project Ngulia (Kenya), the studio of the course Agricultural technology and innovation, and the silver medal flyer of Compaction Prevention System 2021.

5. Analysis of performance goals vs. outcome

Our reflections about outcome vs. original performance goals can be described in different ways. We have tried by the previous sections to provide glimpses of our activities as well as our working philosophy (learning and relationship-building by doing concrete things together) and all these can be related to the goals that we defined in our original application during 2018. In the table below we summarize our interpretation on the achievement in relation to these goals. When we look at our own goals defined in 2017 we now understand that we should have formulated these in a slightly different way. We did, for example, not include an explicit goal to create innovative prototypes or innovations (meaning original concepts put in use).

Table 2. Performance target Agtech 2030 according to the 2018 application vs. outcome.

	Performance target	Outcome vs goals
1	The initiative's implementation organization (work and decision-making processes as well as processes for gender equality work, follow-up, evaluation and improvement work etc) has been designed and implemented.	We estimate that our goal achievement is **HIGH**. We have established and matured a stringent process for engaging in development projects. In-process evaluation models have been implemented and learnings can be capitalized upon.
2	At least two international cooperation agreements have been signed. Agtech 2030 actively contributes within the European Commission's Food 2030 and is active in national and international events such as Borgeby Fältdagar, Agritechnica.	We estimate that our goal achievement is **MEDIUM**. We have frequently engaged in international collaborations. We have maintained the strategic partnership exchange with Food Valley and collaborated with other agrohubs in international contexts. However, we have not finalized formal international agreements.
3	Agtech 2030 has recruited highly qualified employees and key stakeholders dedicated to excellence in joint activities. The financing model for the 2nd phase has been designed and implemented and financing is secured.	Estimated goal achievement is **LOW**. We secured some qualified staff resources necessary to bring the first phase successfully to an end and to design the 2nd phase application. But we should have done more. Our office organization has been week in relation to the magnitude of the activities. Inkind funding has, to a significant extent, been achieved during the first 3 years but we have still not secured financial platform for phase 2.
4	Through collaborations with agtech companies, innovation actors such as Science Park, The Rural Economy and Agricultural Societies, ALMI and LEAD have increased their understanding of, and ability to support, agtech companies.	Estimated goal achievement is **HIGH**. We have, within different projects and actions, worked with business-supporting actors such as The Rural Economy and Agricultural Societies and Linköping Science Park. Dialogue with LiU Holding is ongoing.
5	Based on the activity plan, Agtech 2030 delivers the activities that the initiative's stakeholders and the business community prioritize.	Estimated goal achievement is **HIGH**. We have realized many innovation projects and other activities that we know were high valuated among our partners. We have also supported the establishment of physical innovation environments (e.g. Väderstad).
6	Collaboration between companies and research actors is generally a prerequisite for project funding, and collaboration is stimulated in the development of business plans for the initiative.	Estimated goal achievement is **HIGH**. We have so far supported some 20 multi-actor project collaborations of which 12 are projects including both academia and industry. The estimated total budget for development projects amounts to over 16 MSEK.
7	Agtech 2030 will, especially through Test and Trial Arenas, Machine, Animals, Crop, contribute to at least three companies establishing operations in the region.	Estimated goal achievement is **LOW**. We have supported test and trial arenas in different projects but as so far not focused on establishment of companies in the region.
8	With other actors such as the incubator LEAD, LiU's innovation office and ALMI, Agtech 2030 will contribute to the start-up of at least three new companies.	Estimated goal achievement is **LOW**. We have so far not focused on start-ups in the region, but instead focused on existing partners. But we have had meetings with Almi and others recently to plan for phase 2.
9	An attractive research environment has been created through a center formation comprising Dept. for Economic and Industrial Development, Dept. of Physics, Chemistry, Biology, Dept. for Computer Science, and Dept. for Systems Engineering. The center formation coordinates all R&D in connection with the initiative. Design competence is an important component.	Estimated goal achievement is **LOW**. The university institutions collaborate on different levels of Agtech 2030 including strategic management, scientific leadership and development projects. One or more institutions participate in ca 20 development projects However, we could have done more and plan to do that during the coming years.
10	Needs-oriented R&D-based knowledge is developed through regular meeting activities for researchers and entrepreneurs, specific projects	Estimated goal achievement is **HIGH**. We have realized this objective primarily by supporting development projects with participation of both academia and industry. These projects are vital for aligning R&D with companies' needs. Ca 12 such projects have been launched but other fora such as seminars and conferences are also important.
11	After the first three years, research funding linked to Agtech must have increased by 20% compared with the situation at the start of the initiative.	Estimated goal achievement is **MEDIUM**. We got complementing funding from Tillväxtverket, Sankt Kors and others. We contributed to other funding in the agtech

		area such as AI in the name of Climate (ca 6 MSEC), Sustimal (SEK 48 million). We worked out an EDIH application (total budget ca 30 MSEK). But we could have done more.
12	Agtech 2030 has consolidated its position as a regional flagship initiative and is a natural part of Region Östergötland's communication regarding regional strengths and a prominent example of how the smart specialization strategy is implemented in practice.	Estimated goal achievement is **HIGH**. Region Östergötland is supporting Agtech 2030 as part of the region's smart specialization strategy. See following links to the Region's website or here.
13	Agtech 2030 is being implemented in line with regional and national food strategies. Knowledge and insights are delivered to the national neo-industrialization strategy and to the national digitalization strategy. In addition, the initiative finds synergy effects with relevant strategic innovation programs and national collaboration programs.	Estimated goal achievement is **MEDIUM** for 13 but HIGH for 14. Our activities are in line with, and supports the implementation of, the region's food strategy. See here. However more substantial connections could have been done. On the other hand, Agtech 2030 is well connected to national strategies and contributes actively to national agendas, for example active in Parlament seminars. Agtech 2030 maintains a close dialogue with regional and national policymaking actors. Exchange is facilitated through conferences, seminars and meetings. The impact of this interaction is of mid-to-long-term nature and concrete examples of results are expected during the 2nd phase of Agtech 2030.We have lots of activities that connects to environmental and social responsibility.
14	Agtech 2030 participates in, and actively contributes to, the regional public debate. In particular with regard to agriculture in relation to sustainable development such as environmental and social sustainability, resilience and gender equality aspects, as well as the ability of consumers / civil society to influence production and consumption patterns. Policy learning and renewal are accelerated and streamlined by strengthening existing meeting places (Vreta Kluster) for business, the public sector, academia and civil society.	
15	At least three international R&D collaborations have been started within the first three years. The basis for this is the cooperation agreements with international initiatives that will be concluded.	Estimated goal achievement is **MEDIUM**. We did achieve some but are not satisfied with our efforts. Part of the problem is that the corona pandemic made it hard for us to travel and meet with international partners during our 3 first years.
16	Gender goal: a) at least 30% of the projects shall be led by women, (b) women shall be included in the project group for at least 60% of the projects, and (c) the content and results of the projects shall contribute to strengthening the conditions for both sexes.	Estimated goal achievement is **HIGH**. 9 out of 22 projects hade female project leader (41%). The project selection process of Agtech 2030 ensures that gender perspective is considered. We can do more, for example focus more on project areas were women are more represented, like horse area.

Let us last but not least also point at some "hard" indicators of our first three years. In table 3 we give a self-evaluation comment on each of them.

Table 3. Performance target Agtech 2030 according to the 2018 application vs. Goals and outcome.

		2019	2020	2021	Self evaluation
A	Participating company / year	11	12	19	OK
B	New innovation projects	6	7	8	OK
C	New products in the form of goods			1	Not sufficient
D	New products in the form of services			2	Not sufficient
E	New processes		5	5	OK
F	New prototypes	2	3	7	OK
G	New companies		1		Not sufficient
H	Patents or patent applications		2	2	OK
I	Participating researchers / year	6	4	7	Not sufficient
J	Scientific articles / journals	14	7	15	OK

Appendix 1. Strategy and plan for coming years

1. The vision of Agtech 2030

The vision of Agtech 2030 is the same as we had in 2018: "In 2030, Östergötland and adjacent areas will be one of the world's most prominent regions in agricultural technology – agtech. The region is distinguished by attracting a high proportion of global investment in agricultural-related technology, successful start-ups, applied cutting-edge research in close networks between research institutions and business, large-scale tech companies with international success, high-tech and high-yielding agricultural companies that contribute to disruptive technology and new business models to solve global sustainability goals – as well as a public sector that, through forward-looking action, accelerates innovations and contributes to sustainable development. The vision includes new ways of refining grain products (close to primary production) as well as technological cross-connection with e.g. the forest industry."

2. Goals for next phase

A strategy must contain a description of how to go from the current situation to the desired one, i.e. how to achieve the goals in the frame of the vision.[29] The goals we have set up for the next phase, 2022 to year 2025, are defined as follows:

1 new establishment in Östergötland has been done by at least one existing top-level innovation firm that now have no innovation activities in Sweden but in other countries (inward investments but not from other Swedish regions). And this has been done with Agtech 2030 as instrumental promotor according to written statements from representatives of that company – so we need to prove our role and effort.

10 new collaborative actor constellations have conducted innovative processes by means of activity platforms (innovation projects) organized by Agtech 2030

20 new inventions or innovative concepts have been generated in the frame of Agtech 2030

30 innovation projects have been completed in the frame of Agtech 2030

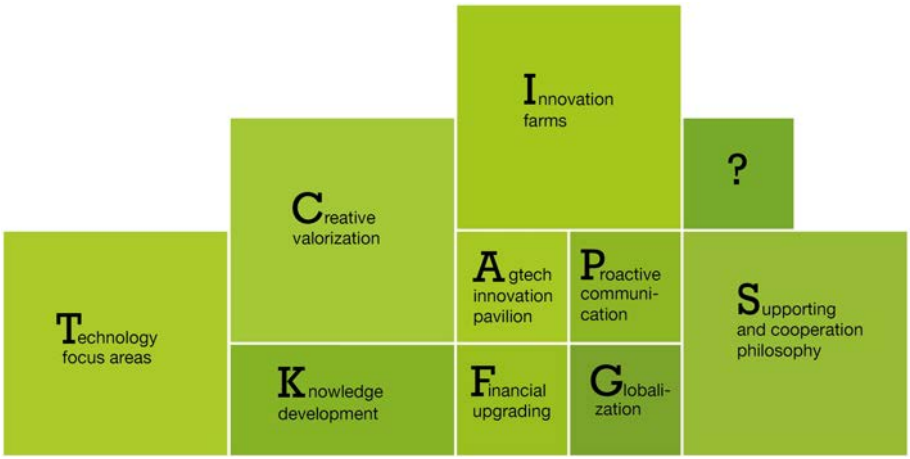
40 articles in leading international press have been written about Agtech 2030 – and thereby strengthened the brands also for Vinnova, Region Östergötland, Linköping University and all other partners.

50 student essays and other reports have been written because of Agtech 2030s activities

All of our projects shall be related to well established sustainability goals or animal welfare (despite the fact that animal welfare is not explicit included in the Brundtland or UN sustainability goals). Our ambition is also that at least half of these 20 inventions or concepts have reached the status of realized innovations, i.e. made a footing among users in the market.

3. Strategy components

Our strategy to achieve the goals is defined by means of 10 components. These are linked together and will support each other. Some are estimated as being more important than others but the exact relative importance will be investigated during the implementation process. Therefore, look at the overview illustration with a grain of salt. As seen, we leave one component open, because we want to be flexible and may get new ideas to complement the strategy.



10 strategic components + one open option.

In the following text will the components in this figure be described.

4. Technology areas to focus on

The starting point for our choices of technology areas to focus on is based on a model we call sweet spots. It is about analyzing interfaces between 1) Challenges and needs of actors in the agricultural industry, 2) The competence profile in our innovation system and 3) What others outside our innovation system around the world are doing. By sweet spots, we mean the interface between challenges and needs of farmers and our ability and capacity -but outside the area of what is already happening has already happened elsewhere. Some reflections on this: We want to be responsive to needs from the agricultural industry. Therefore, we invest significant resources in interaction with entrepreneurs in agriculture and companies that focus on agriculture. However, we are open to the fact that not all needs are always expressed by those who have the need. To quote Crister Stark at Väderstad: “Who needed rubber boots before they existed?” As for our competence profile, it is about the overall competence and ability that exists among all of us who are part of Agtech 2030 – but also which is available to us through relationships with others. In this respect, the region's areas of strength are something we carefully consider. Furthermore, we do not want to ”do the same thing” that is already being done by others in our region. Rather, we see collaboration with these as an important opportunity. Nor do we want to focus on things that others already do, have done or have started to do elsewhere in the world. To take this dimension into account, we have invested large resources in global analysis of the surrounding world, not least through participation in international fairs. The areas we have chosen to focus on (and select subareas to engage in) are:

- Connected safe and robust systems in agriculture
- Visualization and image analysis in agriculture

- Artificial intelligence and data analysis for idea generation and decision making
- Mechatronics and enclosures in agriculture

We are convinced that these technologies can help overcome conflicts among urgent sustainability goals. We will thus have in mind that the technologies with advantage should support urgent sustainability goals such as climate care, biological variety care or soil care. We have also in mind that technology must be connected with profitable business models if it shall create substantial value. Let us describe some about each technology area:

Smart, safe and robust connected products and systems have strong connections to agriculture. Field machines and animals are today equipped with connected sensors and much of the processes are controlled thanks to connected products and systems. Ground sensors and sensors aimed at growing crops can also be mentioned here.

Visualization, simulation and image analysis have a wide field of application, but even here agriculture is central in many ways. Not least image analysis of crops and animals is included among the areas of interest. But here should also be mentioned sensors and systems that enable preventive maintenance, remote service, etc. of agricultural machinery. Another area is digital twins, which have already begun to spread in agriculture. Various forms of information visualization are also central.

Artificial intelligence and data analysis for idea generation and decision making is very central in agriculture, and we know that Östergötland has strengths in this area. We are not only talking about decision-making because we know that AI and data analysis can also bring new ideas, not only help when a decision is made.

There are connections between the areas above and we are dedicated to explore these connections in co-operation with Visual Sweden. One example is to fulfil the dream of digital farm as a 3D model and as tool for making overviews of the many sub-systems that exist on advanced farms. The image below is from our experiments on this that took off recently:

A 3D digital twin model of Rotenberg Manor made by Oscar Hoffmann in co-operation with Team Rotenberg.

We know that digital technology is not enough to create value in agriculture. Therefore we also focus on mechanics and not least mechatronics. Moreover, we know agriculture involves stressful environments where such things as temperature changes, humidity, chemicals and kicking animals are commonplace. Furthermore, there are (as our chairman of the board Peter Borring has pointed to) machines that stand still for long periods of time, but which must then function smoothly during e.g. sowing or harvesting. During the long times that the machines are stationary, moisture, dust, rats, corrosion, and other things have time to affect electronics if they are not connected properly. That is why we have highlighted enclosures in agriculture as part of our focus.

Östergötland has certain strengths areas and we connect mainly to two of the selected areas. We must mention that there also is a strengths profile of our larger region Eastern Central Sweden (ÖMS). Part of the focused areas within ÖMS is "Sustainable food supply". We share that vision, but add that agriculture also provides other services than just food. Kolmården's animals eat feed produced in agriculture and results in experience and species conservation services. Natural grazing provides ecosystem services. But more important, agriculture contributes with fiber and energy production and regarding energy it is vital also for securing further food production not least in the event of chaos and war in the outside world.

5. Boosting creative valorization

We believe that during the first 3 years of Agtech 2030 we were quite good at developing innovative concepts and bringing these from idea to demonstrator stage. But we are also aware that we have been less good at valorization. By valorization we mean value creation out of innovative concepts. In most cases that is about commercialization, e.g. put innovative concepts on the market. But sometimes concepts can create value without market mechanism, for example if a smart method is spreading among farmers without any invoicing. In the coming years, we want to place greater focus on really developing products and service concepts that are ready for customers. We are inspired by what we have seen in Food Valley in Holland, e.g. how the company AgroCare (formerly SoilCare) developed concrete products based on its knowledge and visions. Furthermore, we want to place more emphasis on commercialization processes as a whole. That includes directing product design based on empathetic knowledge of potential users' needs, wishes and ability to pay, as well as initiating processes that help to promote the final design. All this is not "design theory", it is about basic marketing. This is how Philip Kotler wrote in the original edition of his book Marketing Management from 1967: "Marketing's short-run task may be to adjust customers' wants to existing goods, but its long-run task is to adjust the goods to the customers' wants."[30] However, we still want to place the emphasis on product development and we mean those that are based on both technical know-how and understanding of customer needs, wants and paying ability ie. empathetic market analysis. By *creative* valorization we refer to smart business or communication concepts that can speed up the valorization process and expand its magnitude. A historic example of such creative approaches is the Guinness company who came up with a book of record to boost the beer drinking in bars and spread the product Guinness and not least the brand. Another example is John Deere who created the Furrow – the first company magazine (not focusing on product promotion but to help farmers with ideas that can boost business). The tire manufacturer Michelin created the Guide Micheline to promote car tours. We have investigated many such cases and also written down this in books and articles.

Regarding business models we will try experiments with cooperation-based business ones. When starting from constellations of companies, rather than individual companies, it is conceivable that existing models of business models do not fit well. There is a need for model development. To sum up, we will secure capacity in Agtech 2030 in these valorization areas:

- Designing products ready for market launch out of demonstrators or demos
- Marketing in the sense of methods to understand potential user's needs, wants etc.
- Marketing in the sense of creative promotion of finalized products
- Cooperation-based business models

Both regarding business models and marketing we see opportunities to connect with the high competence that exist at Linköping University, the Almi company, at LiU Holding and others.

6. Useful knowledge development

We want to invest in a well-balanced palette of knowledge-raising initiatives to support our innovative processes and to inspire now ones. By knowledge we mean research-based knowledge but also other knowledge. We think that we have had some success in knowledge development during our first 3 years, which is indicated by the scientific and other publications that we have generated. But we have been far too narrow when it comes to making contacts in the fantastic world of Linköping University. Admittedly, we have managed to connect with some parts of the university (4 institutions and departments in sensor systems, computer vision, biology, hydraulics, workshop, economics and climate) but there is much more to discover and do. Our plan is to expand our collaborations and do it in a way that it supports our chosen technology areas while we at the same time must always ensure that investments in knowledge are based on the needs of agriculture and that these needs are explicitly expressed by our business stakeholdes. Opinions among academics about the benefits are thus not sufficient to justify economic investments by Agtech 2030.

Students in different educational programs is a very important resource for Agtech 2030. We have worked quite much with students but during the corona years it was hard to arrange physical seminars. The photo here is from a conference on cooperative business models in relation to agriculture that we arranged together with Almi and others before the corona pandemic. We did mix students with researchers and companies and this mixing is really fruitful and something that we will continue to include in our strategy.

The conference on cooperation-based business models (students, researchers, and practitioners).

We want to increase our contact areas and collaborations with professional players in the agricultural industry but also among mechanical engineering companies and technology companies. We are aware that modern knowledge is not only created by academics. In today's knowledge-based world, universities, institutes, and companies often act side by side in both innovation work and knowledge development including research.[31]

7. Innovation farms

There are several farms around the world that are defined as test farms. Common concepts are test beds, test yards and ”agtech testing grounds”. During our first 3 years, we also spoke in terms of test beds. But during our 3 years we have reconsidered our and others' perspectives. Concepts such as test yards are based on the premise that one *already has something that needs to be tested*. In innovation processes, such situations arise in later parts of the processes. We believe that professional farmers can contribute with innovation by introducing needs or contributing innovative ideas already as an origin to what can later become innovation processes. We

even want to allow ourselves to criticize several of the large global agricultural companies that tend to develop prototypes and only then put them to the test on farms. We want to highlight agricultural farms and farms as a force during the entire innovation process, including the early stages and in the stages that exist before an innovation process has even started. That is why we want to use the term Farm-based innovation centers. It is not only the farmers there who can contribute to the innovation processes, but we believe that teams of people from different places can contribute to it, but based on the physical places and contexts that we call Innovation farms.

Some of the innovation farms will, hopefully, be partner to some new international innovation player that invest in a facility in our region during the time of this strategy. The selling proposition to this potential entrant will be that our innovation farms can add lots of value regarding telling about true problems and by providing new wanted concepts – they will not only have a role as "test lab" for near ready products (which, as said, is almost often the case).

8. Agtech innovation pavilion

We want to build a future-oriented innovation house or pavilion both in digital and physical mode. The physical house/pavilion (see the idea mockup below) shall (if we may so) be situated in the coming food experience park in Mjölby municipality and the digital twin of this pavilion shall be integrated in Vreta Kluster, Linköping University and in cyberspace. We may not finish this during until 2025 but we will try to.

A thinkable "agtech innovation pavilion" located in the food experience center that probably is going to be created close to Väderstad in Mjölby Municipality thanks to a partner team including Agtech 2030, Saab, Biototal, RISE, Väderstad, Visual Sweden, Svenska Ägg, Lantmännen, LRF, KLM, Agro Örebro, Region Östergötland, County Administrative Board Östergötland, The Rural Economy and Agricultural Societies, Östgötamat, Vreta Kluster, Swedish Meet, Swedbank – and Food Valley in the Netherlands. The functions of such an innovation pavilion include idea sharing, demonstrations, dialogue promotion and general promotion of the agtech field.

9. Supporting and cooperation philosophy

We will continue to support innovation in a proactive way working with the philosophy "learning and relationship-building by doing concrete things together". The model we primarily work with do we call activity platforms. We will engage in stimulating actors to join common (project) visions and then form development projects to fulfil these visions. Actors forming such platforms must provide stakes in form of 1) Commitment, 2) Ideas, 3) Knowledge, 4) Work, 5) Criticism, 6) Money and 7) Contacts. By means of cooperation with these stakes the actors then engage in innovation projects leading to a "return" in form not only innovative products or services but also learning, image effects and publications. See figure.

The activity platform model defining stakes from and return to different partners that join a certain project vision.

One success factor for Agtech 2030 is to have people onboard that really understand innovation and can connect in discussions with others in innovation issues. Agtech 2030 support these kinds of process by stimulating information and idea flows leading up to project ideas, contact supporting and financing.

10. Globalization pathways

We will continue our efforts to connect with people and innovation processes in other countries. Wi will do so by help of trade fairs, conferences and personal direct contacts. We have already started some processes that may lead to expanded globalization, for example the EDIH project Agrihub Sweden. It is easy to have dialogue with people but to really "get in" and succeed in being an innovation partner one need not only an own need for doing so. One also need *something to offer* for others. Therefore, we will continue to work hard to participate in the international front lines around certain areas of innovation. For example, we have already made a booking of a stand at DLG Feldtage in June 2022 (see photo from earlier year) and plan to showcase both the Flexrow machine and the Compaction Prevention System.

DLG Feldtage, one of the most important outdoor events in international Agriculture. Photo: DLG.

11. Idea of financial upgrading

We have done some in financial, upgrading for example the Smart Agtech project. The main effort, however, the Agrihub Sweden application (ca 3 M Euro) to the EU Commission together with Visual Sweden and others (see illustration). We have also been active to submit tenders for strategic procurements around data hubs etc to prepare for actions after the summer 2022. We think also that we can be part of some of Vinnova's ongoing or coming visions around sustainable food. See here for example: https://www.vinnova.se/m/hallbara-matsystem/. In addition, great funding opportunities are expected to come with the European regional Development Fund (ERDF) in the coming period.

12. Proactive communication

First and foremost, we argue that communication is more about what we do than what we say. Most of what we do will be communication. And all we say and do will build up our brand. Our definition of our brand is the following: "The sum of what we do and say over a long period of time, interpreted in the eyes of the viewer, together with the effect of influencing external factors." All we have written about above is thus part of our communication strategy, for example our plan to build up an innovation pavilion. With this said, we want to add this: We will design marketing communication based on three paths: Inbound, Outbound and Surgical.

With "inbound" we mean a strategy to make it easy for potential partners to us to really find our offer when they are looking for solutions or looking for interesting ideas to develop their farms or technology companies. This in turn is about two things: creating an interesting substance and making sure to be in the places and in the channels where our seagull groups seek their information. Working with semantic language analyzes on the web (many different words and expressions) and not least in social media will be central.

By "surgical" we mean the selection and active search of people who are interested in agricultural innovation. For example, we will look for farmers who a) have shown proof of liking innovations, b) have a clear interest in sustainability colors and c) are strong and willing enough to want to invest in exciting innovation projects.

By "outbound" we mean efforts to spread the message about our concept proactively towards different segments. Advertising is something we should try to avoid as we do not think the effect is worth the cost (compared to alternative methods). But articles in the trade press will be an important component in our effort to publish information about our upcoming product. By articles is meant here both those we write ourselves and articles that journalists will write about our invention. We have a skills and experience in writing articles in trade press and have historically also managed to get a significant amount of editorial press. Our archive of this contains over 500 articles including international magazines such as Farmers Weekly and Profi.

We will have a special focus on trade fairs and field days in the communication strategy in the coming years. There we can practice all three communication methods above. Trade fairs are a cost-effective way to meet many potential interesting persons and make it easier to demonstrate complex products. We can add that in social media we include our own website with dialogue functions. Keywords to use in our various posts and descriptions are central here.

13. Mobilizing strong management and headquarters

We understand that the expansion of Agtech 2030 that will follow (hopefully) needs a stronger management team and headquarters organization than we have today. In fact we have accelerated this expansion process by means of dialogue with Grants office at Linköping University and potential employees etc. We need both stronger support to the strategic management (including support to the process leader) and stronger office platform. In this expansion we need more people and the right ones. The competence and personal profile of these coming members are crucial

for our success. Generally, it is important that these persons have the right competence, have ability to cooperate, want to put in hard work efforts and have willingness and “drive” to realize the vision of Agtech 2030. But as important is it that these persons are flexible and nice to each other, because it is, of course, not an easy thing to manage an entity such as a Vinnväxt program. There will always be struggles to overcome. But the good thing is: We have learnt a lot in our first 3 years and are ready for expansion.

Appendix 2. Endnotes

[1] And also these: Agroväst, AgroÖst, Energiutvecklarna Norden, Interactive Institute, JTI, Lantmännen, Prodelox, Vreta Kluster, VicVision and Svenska Mätanalys. The different actors were involved in different grade.
[22] We can mention also that at Agricultural Innovation Day we presented the vision of digital 3D-model of a farm that could be the basis for future decision-making system. This idea was also part of our marketing of Agtech 2030 in the Autumn 2017 and is now (February 2021) finally going to be realized.
[3] The full version is found in Appendix 1.
[4] The reason why XMReality discontinued the partnership was according to our interpretation that they had a stricture business view that did not fit with our long-term co-operative vision.
[5] The logo symbolism was very in-depth analyzed. The logo should signalize technology, future (not history) and connectedness. The logo should be unique in relation to other symbols or logos. Here is one of our original description of this that also include some of the graphic philosophy and handling of partner logos. As seen not all partners are included in the baseline and this had many reasons.

[6] AgroÖst is a main member agricultural organization in Östergötland.
[7] In October 2020, the Board announced changes in Agtech 2030's process management. After that, there was extensive turbulence. Of course, this affected the business in an unfortunate way. An important lesson is that the people who will staff an advanced organization mean a lot.
[8] The team has also been the general chairs for the international conference Fusion (the flagship conference of ISIF). The logotype of Fusion 2020 is inspired by the wildlife collaboration.
[9] From Agtech 2030 participated Per Frankelius but here were also Anders Carlsson and Felicia Lai Jakobsson at Visual Sweden.
[10] Participated did i.a. Professor Kalle Åström (Lund University) and Andreas Oxenstierna (T-Maps), Magnus Westöö (HS Östergötland) and Per Frankelius (Linköping University).
[11] Axel Lagerfelt (Tolefors), David Löwenbrand, Sensorbee and Malin Alm, Vreta Kluster participated here.
[12] The jury's motivation was “The competition entry has a high innovative height and the new technology has the potential to be used in machine development for several agricultural crops”
[13] With this motivation: “With energy and enthusiasm, Per Frankelius constructively questions the establishment of climate research with the goal of opening up new calculation models that include agriculture's climate relief, not just burden”.
[14] Including the United Kingdom, Switzerland, Germany, Russia, Bulgaria, Greece, Ukraine, Hungary, Argentina and the United States
[15] LiU = Linköping University. HS = The Rural Economy and Agricultural Societies. IFM = Department of Physics, Chemistry and Biology. ISY = Department of Electrical Engineering. SLU = Swedish University of Agricultural Sciences.
[16] The project then aimed to stimulate processes based on their thoughts and bring the thoughts a few steps closer to products or services that facilitate, improve or even revolutionize agriculture. Through the platforms, farmers would together - and with the support of innovation leaders - discuss challenges and solution ideas. Furthermore, access to external expert help was provided.
[17] The method included the steps Awakening (putting a challenge in focus), Pre-emptying (defining what is important), Criticizing (kindly criticizing) and Embodying (embodying concept). The background to this project is experiences from working methods that had been tested previously within Agro Sörmland and which, among other things, led to a today patented robot that interacts with combine harvesters as well as concrete business development among horse-related companies.
[18] Neurodesign deals with the connection between work environments and its design on the one hand and what happens in our brains on the other hand - and after our senses take in visual impressions, smells and sounds etc. from an environment.
[19] The magazine commented: “In the UN's climate panel IPCC reports, agriculture should benefit the photosynthesis behind the grasses' crop as a positive contribution in climate work. This is the opinion of innovation researcher Per Frankelius in this summer's featured article in the Agronomy Journal. Now he is in place 7 on Land Lantbruk's 50 list.”
[20] The workshop was led by Niklas Tideklev at Region Östergötland and Johan Lilliecreutz, LiU Holding. Among the participants were NIRA Dynamics AB, SICK IVP, ACTIA Nordic, Combitech, Visual Sweden, Ericsson, Saab Dynamics AB, Linköping Science Park, Norrköping Science Park and Agtech 2030.
[21] From Region Östergötland, Malin Thunborg, Head of Unit for Regional Growth and Marketing, participated; Richard Widén, Regional Development Director; Anna E. Jacobson, Strategic Rural Development; Carina Malmgren, Strategy, Innovation and

Business Development, Regional Development; Martin Tollén, Member of the Regional Council etc. From Agtech 2030, 4 people participated.
[22] In more detail: Expert Reviewer for the Government and Expert Review of the Second Order Drafts of the Sixth Assessment Report (AR6) and the first drafts of the Summary for Policymakers and the Technical Summary".
[23] Per Frankelius did the analysis and wrote the consultation response but had help from prof. Mikael Ottosson, senior lecturer Lotten Wiréhn and prof. Louise Ödlund.
[24] During 2021, tracking tags were added to the system, so the owners can see where the animals are, and thus saving time to find them, and detecting animals that have left the enclosures. The next step is to add intelligence to the tags, so they can detect stress, diseases and injuries and alert the owners. Several other sensor system for monitoring drinking stations, electric fences etc will also be added.
[25] In co-operation with the Crop Science Society of America and the Soil Science Society.
[26] Other partners are RISE, Statens Veterinärmedicinska Anstalt SVA, Uppsala University, Dalarna University, Lantmännen, Lantbrukarnas Riksförbund, The Rural Economy and Agricultural Societies, Norrmejerier, KLS Ugglarps, Agroväst, Växa Sverige, Gård & Djurhälsan, Föreningen Svenskt Naturbeteskött, Svenska Vallföreningen."
[27] Example: insect catching boards
[28] Some info: Farmers know that healthy soil is one of the most important factors behind high yields and long-term profitability. However, soils are under threat nowadays due to soil compaction. Around 1980, a tractor weighed an average of about 6 tonnes. Today, the average tractor's weight is around 7 tonnes. Compaction affects root development of plants. Second, compaction affects water flows. Third, compaction affects nitrogen processes. Fourth, compaction harms the biological life. Fifth, compaction affects oxygen access. If the soil is low in oxygen, anaerobic bacteria will thrive. Some of these convert nitrate to nitrogen gas and nitrogen oxide (nitrous oxide). Both nitric oxide and nitrogen gas then disappear into the atmosphere. Thus, the soil loses nitrogen which could have contributed to the development of crops. In addition, nitrous oxide is negative for the climate. The Compaction Prevention System (CPS) enables continuous and automatic monitoring of expected soil compaction given every specific situation regarding load, vehicle footprint, soil type, moisture and other factors. CPS also enables overview of fields and help future planning of driving in the fields. Thus, people responsible for driving vehicles at farms can make the right decision to minimize soil compaction – both in real time and as part of planning. The concept uses radar data from satellites as well as soil maps and other input.
[29] The literature in the field of strategy shows that there are many views on strategy. While military literature, large parts of business literature and game theory literature focus on relations to competitors, one could distinguish between the following types of strategic perspectives: Strategy in the sense of competing with some opponent, Strategy in the sense of winning someone's favor (eg customers, financiers, citizens' votes). Strategy in the sense of succeeding in accomplishing something difficult (eg succeeding in developing a process that leads to innovation).
We think that only the last two kinds are relevant for us to consider. We believe that the following commandments should show the way to a successful strategy: A strategy must be based on a qualified analysis of the surrounding world – on conditions and opportunities. A strategy must be based on a clear goal, i.e. a statement about exactly what one want to achieve in comparison with the current situation of the target variables - and during what time it should be achieved. To be meaningful, a goal must be preceded by a clear current situation image. Moreover, a strategy must be based on a careful analysis of what resources and benefits one have that are important for the implementation of the strategy.
[30] Kotler also have the perspective that a "product" can be both a good and a service. In fact it can be more than this. Consier this citation from the same book: "The idea of a product seems intu tive; yet there is a real problem in knowing exactly what it embraces. Consider a camera. Viewed physically, it is an air-filled assembly of metal or plastic parts surrounding a lens. It may come with an attractive box bearing a bright brand trade mark. To the buyer, the company's product is composed of these elements plus the services the seller and manufacturer make available as part of the purchase. But the camera is more than the boundle of physical parts and company services. The buyer sees the camera as a means of satisfying certain needs and desires. The camera promises him pleasure, nostalgia, a form of immortality. It may be means of expressing artistic or craftsmanship instincts. It can be a symbol of status and a means of relating to other people."
[31] For example, IBM 2 has the Nobel Prize only in Zurich and one can remember that Carlsbergsbryggeriet invented the pH scale and that Valio in Finland received the Nobel Prize for the silage method. We are very much inspired by such examples. One example that we have studied much is this: John Deere began a partnership with NavCom Technology, Inc., which specializes in GPS signal receivers and was founded in 1992 in Torrance, California. In 1996, thanks to NavCom, John Deere was able to launch a satellite receiver that was the forerunner of what would later become known as StarFire. But it was realized that the precision needed to be greater and the question arose about correction singles. At Stanford's GPS laboratory, experiments were made with pseudolites (”pseudo-satellites”), transmitters on the ground that complement the satellites. A technology, developed by TAU Corporation in Los Gatos and Magnavox in Torrance, came to be known as ”differential GPS” (DGPS) where fixed stations with known positions correct the GPS signals. The precision was 1 meter. Leading the world in correcting signals was the NASA Center Jet Propulsion Laboratory (JPL), which already in the 1960s devoted itself to interpreting signals from outer space. There, too, during the early 1980s, a system for correcting real-time satellite tracking data through a network of base stations had begun to be developed. By establishing collaborations between the mentioned players - Jet Propulsion Laboratory, Stanford and NavCom - John Deere was able to launch auto steering, the product AutoTrac 2002.